PICRIC ACID HAZARDS

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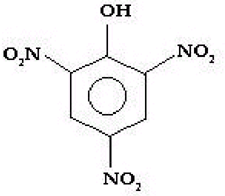


Every couple months, an article appears in the local paper about a bomb disposal team removing picric acid that was found in a laboratory. The material is usually taken to be blown up. So why is picric acid considered so dangerous? Well, let's look at the history of the use of Picric Acid and see what can be done to avoid those types of situations.

Picric Acid (2,4,6 Trinitrophenol) is frequently found in forensic laboratories for use in the Christmas Tree stain (1) and for Urine detection (2). Histology uses include connective tissue stain (Jullien's picroindogocarmine and Van Gieson's picro-acid fuchsin), cytoplasmic stain (Van Gieson's with iron hematoxylin), woody sections (picro aniline blue) and as a fixative agent (3). It was used in medicinal formulations in the treatment of malaria, trichinosis, herpes, smallpox and antiseptics. A one- percent solution was also used in the treatment of burns (4).

British Chemist Peter Woulfe discovered picric acid in 1771. Picric acid was named from the Greek word *pikros*, which means "bitter" due to its bitter taste (5). It was used to dye silk and wool yellow. Workers making picric acid during World War I were called "canaries" because their skin was stained yellow (6).

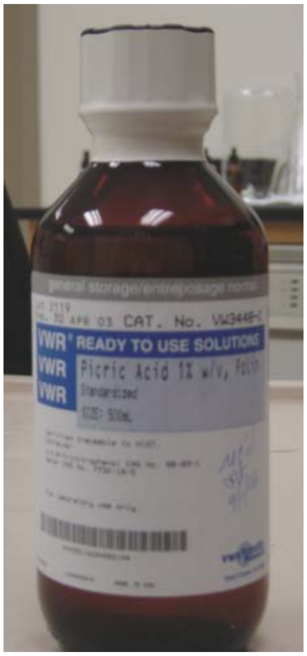
The explosive characteristics of Picric acid were discovered early. In 1885, experiments with picric acid were conducted in Lydd, England and the English adopted it as an explosive material called *Lyddite* in 1888. It was used extensively in bombs and grenades during World War I (7). Anhydrous Picric acid is similar to TNT. It needs usually needs a "booster" such as a primer to create the explosion. However, as a strong acid, picric acid attacks common metals (except tin and aluminum) creating explosive salts, which are shock-sensitive. Bombs, mines and grenades were coated with tin or ashpatim to prevent the picric acid from contacting the metallic shell (8).

Several catastrophic events involving picric acid have occurred. On December 6, 1917, an ammunition ship in Nova Scotia carrying 2,300 tons of picric acid as well as 400,000 pounds of TNT caught fire and exploded. Over 1,900 people were killed immediately and 9,000 were injured (9). Shock-sensitive metal picrates demonstrated their hazardous nature on May 1, 1916 when a fire at a French ammunition factory caused molten picric acid to flow onto the concrete floor. Calcium picrate was formed and detonated, killing 170 people (10).

Have there been any explosions in laboratories? There are no documented instances of spontaneous detonation of picric acid in a laboratory (11). The Department of Transportation classifies Picric Acid (Trinitrophenol) with less than 30% water by mass as a Class 1.1D explosive; with greater than 10% water by volume, it is a class 4.1 flammable solid (12). In the wetted state, it is unlikely to be an explosive hazard. If a bomb squad tries to blow it up, the picric acid will not detonate (13) and will just spread picric all over the area!

The big concern has been with finding dehydrated picric acid. The most dangerous situations is if the bottle is old and has a metal cap. Under these circumstances, shock sensitive metal picrates may have formed on the cap contact area. Explosive experts should be contacted under these situations. Knowledgeable bomb disposal experts will use a robot to pick up the container and place it in water to re-hydrate the material (14) or remove it for detonation elsewhere.

If a ***plastic*** cap is present, and the acid inside has dried, some crystals may be on the threads and the friction of removing a plastic cap might be enough to detonate the container. Under these circumstances, the container may be safe enough to place in a pail of water. Submerge the bottle to allow water to enter the cap and threads and dissolve any crystals that might be on the threads. Add ice to cause shrinkage of the bottle to enhance penetration of the water. Leave it like this for several days, until water can be seen inside the bottle. At this point, it is safe to open the cap and re-hydrate the acid inside (15). Whenever in doubt, contact explosives experts.



Of course, an ounce of prevention is worth a pound of cure. If you really need to have picric acid in your lab, here's what you should do:

1. Make sure that the picric acid is kept wet! Do not open a new bottle until needed. Then date the container to show when it was first used to help you in a routine inspection program. As part of your lab inspection program, check the hydration of your picric acid at least every six months and add distilled water as necessary.
2. Do not use metal spatulas to remove the material.
3. Be sure to clean the bottleneck, cap and threads with a wet cloth before resealing (16).
4. Get rid of old bottles with metal caps
5. Do not store large amounts of picric acid. Dispose of your picric acid every two years (17).
6. If possible, eliminate it from your inventory by purchasing premixed stains or a 1% solution for using in stain preparation.

If you decide to dispose of your wet picric acid, several options are available. First, you could try reducing the picric acid to a non-explosive form using sodium hydroxide and sodium sulfide (18). After this treatment, the material will still be toxic and have to be disposed of as hazardous waste. Alternatively, it could be manifested as a flammable solid for hazardous waste and disposed of by incineration. DO NOT pour it down the drain; it could react with copper or iron piping to form the explosive salts.

As a last consideration, Picric Acid is toxic. Ingestion of 1-2 grams would cause severe poisoning. The dust is irritating to the skin and eye. A peculiar effect on the eye is "yellow" tainted vision. Systemic poisoning causes headache, vertigo, nausea, vomiting and diarrhea. The skin will turn yellow in severe exposures. Red colored urine may be produced (19). These symptoms would not expected in the laboratory environment under traditional uses.

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